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Analysis on serialized expressions of rational numbers

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Abstract. Rational numbers can be serialized, in other words, rational numbers can be expressed in a regular, ordered way. This paper discusses the background, reasons and methods of rational number serialization, and also identifies the rules of rational number serialization, derives a unique sequence of rational numbers, identifies the expressions for rational number serialization, and lays the foundation for the use of rational number sequences in mathematics. The purpose of serializing rational number in this paper is to make transmitting and storing data more easily, and gives a better way for researchers to do further Mathmetics studies.

Keywords: serialization, rational, irrational, numbers, infinite.

1. Introduction

Rational numbers are infinite, as large as positive infinity and as small as negative infinity. Even with the most advanced computers it is impossible to write out all the rational numbers. In education, seemingly disordered rational numbers make plenty of people like children confused [1]. Due to its importance in mathmetics, someone use bad way to force themselves recite the concept, but that is not a good way. Therefore, this paper discuss how people can express them in a more convenient way. And, since rational numbers are infinite and inherently disordered, this paper also try to figure out how people can make them show visually in a regular form.

The purpose of this study is to make the rational numbers, which are originally disordered and infinite, result in a sequential treatment and become an ordered, regular set of numbers. This will enable people to better understand rational numbers, understand the composition of rational numbers, and understand the relationship between numbers. According to previous studies, we know that rational numbers are discrete and infinite. This paper tries to turn seemingly disordered combinations into ordered combinations, so as to make transmiting and storing data more easily, and gives a better way for researchers to do further mathmetics studies.

2. Introduction to the basics of serialization

This chapter is the basis for the subsequent work in this paper and contains an introduction to the conceptual features of serialization.

2.1. The concept of serialization

Serialization, as the name implies, is the process of making each individual in a collection orderly. Serialization is a form of organization, the process of converting the state information of an object into

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a form that can be stored or transmitted. Many coder, when they need to read and store the data, they often use serialization to make text in order instead of chaos [2].

2.2. Characteristics of serialization

Serialization has three main characteristics. First, each element is countable and discrete. It is stated in Gödel's incompleteness theorem that for any finite number of axioms about the structure of natural numbers, there exists a proposition about natural numbers, is true, but cannot be introduced (proved) by. In this set that is serialized, each element, the numbers are countable one by one. Each number exists independently, and they can be considered as an individual, existing separately in the serialized set. Second, in the serialized sequence, each element has a determined number of successors and predecessors. It is similar to the Peano axiom. For example, in natural numbers, each number has a determined number of successors. 1 has a successor of 2, 2 has a successor of 3, and so on. These numbers follow a+=1 as a rule to determine the number of successors of each number. It can have only one definite successor number. The same is true for serialized sets. Third, every serialized set has a unique first element, also called the zeroth number. In a serialized set, the elements are ordered by 0, 1, 2, 3, 4, 5.... Only when a serialized set can have the first element, he can orderly run down according to the rules and get a complete, conforming serialized set. Of course, serialization is not only related to the way this paper serializes rational numbers. It has many other kinds. For example, when a server interacts with a client in the Internet, the existence of information can be ordered by version or time [3]. This allows a variety of different files to be ordered through time.

3. Introduction to the fundamentals of rational numbers

3.1. The concept of rational numbers

All the numbers in the world have a natural number as their beginning. From the five axioms of Giuseppe Peano, we have the concept of natural numbers defined out [4]. With natural numbers, people later thought that the world must have positive and negative sides, good versus evil, so since natural numbers include zero and 1, 2, 3, 4, 5..., does it also mean that 1, 2, 3, 4, 5... also has an opposite side, -1, -2, -3, -4, -5...? The concept of positive numbers and negative numbers comes into play. With positive, zero, and negative numbers, a new concept was defined - the integer. When the concept of integers was created, the concept of fractions was also constructed. The origin of fractions is "division". A piece of land is divided into three parts, one of which is one-third. One third is an expression that is written down in a special notation to become a fraction, and the concept of a fraction was developed through long experience in dealing with such problems. Along with whole number fractions, there are decimals. Decimals can be equated to some extent with fractions. Because they are not integers, and because decimals and fractions are convertible in some cases. For example $\frac{1}{2}$ and 0.5, they are numerically equivalent. From this, previous generations then summarized these three parallel concepts together to arrive at rational numbers.

3.2. Characteristics of rational numbers

To understand the characteristics of rational numbers, it is useful to start with irrational numbers. It is well known that irrational numbers were born in 500 B.C. when Pythagoras' disciples discovered that the diagonals of a square could not be expressed in numbers. This incommensurability was so different from the Pythagorean philosophy of "everything is a number" (meaning rational numbers) that it caused a great panic in the mathematical community [5]. That it cannot be expressed in numbers does not mean that it cannot be written out in numbers. It means numbers are endless so that numbers cannot be written out and expressed. It is without laws to speak of. By this time, and later with the refinement of people, the concept of irrational numbers was born. Then, just the opposite, the special this of rational numbers is that all are countable and can be expressed.

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3.3. Adjustments to serialization made by rational numbers

Then, in the process of serializing rational numbers, we have to make some adjustments to the rational numbers to make them fit the serialization feature. Rational numbers are inherently disordered, and the feature of serialization is to make this object orderly. After research, we found that integers can be converted into fractions, and decimals can also be converted into fractions. For example, 1 is equal to $\frac{1}{1}$ and the aforementioned $\frac{1}{2}$. The integers and decimals are not convertible at all, so we can treat fractions as an intermediate quantity. This is the same reason why different fractions are added together. It is convenient for us to calculate and arrange. To sum up, we can write all rational numbers as presented in the form of fractions.

The next step is the establishment of each item, and the determination of the zeroth term. Since the opposite of zero is itself, it does not have a relative value, such as 1 to -1 and -0.198 to 0.198, so it is convenient to use zero as the zeroth term to do this serialization expression.

3.4. Serialized expressions of rational numbers

People can be inspired by the results of serialization of natural numbers and integers. With 0 as the zeroth term, the natural number is 0、1、2、3、4、5 ..., the general term formula is $An = 0 + (n-1) * 1$, which is simplified to obtain$An = -1 + n$. The integer is expressed as 0、± 1、± 2、± 3、± 4、± 5 ... The common term formula is$\mathrm{An} = \pm[0 + (\mathrm{n} - 1) * 1]$, simplify to get$An = \pm[-1 + n]$. Since we now only need to think about how to express fractions in an orderly way, and fractions are made up of numerators and denominators. The numerator and denominator are integers, so when expressing the fraction evolved from rational numbers, we can use the general term to express the numerator and denominator of the integers, and then the fraction evolved from rational numbers will be expressed. Thus, rational numbers can be expressed as0、$\pm\frac{1}{1}$、$\pm\frac{2}{1}$、$\pm\frac{3}{1}$、…、$\pm\frac{1}{2}$、$\pm\frac{2}{2}$、$\pm\frac{3}{2}$、…、$\pm\frac{1}{3}$、$\pm\frac{2}{3}$、$\pm\frac{3}{3}$... This pattern continues. The common term formula can be written as An. We can give a name to this serialized rational number by defining it as Q^S .

3.5. Combining ideas and computers science

This idea can also be combined with computers.

```
a = 1
for a in range(Z):
    for b in range(Z):
        print(b/a)
```

Figure 1. Example of Double Loop.

As shown above in Figure 1, the method of serializing rational numbers in the previous subsection can be thought of as a double loop in python. This expresses all rational numbers very well. This idea used not only in computer science but also management. By using and thinking this idea, it can greatly improve one' ability to think and discern [6].

4. Conclusion

All in all, when successfully serialized, the following results can be obtained. (1) Given an arbitrary rational number, people can derive its ordinal number. Given an arbitrary ordinal number, we can write this rational number; (2) Any number corresponds to a unique number, and any number corresponds to a unique rational number. In this way, this study gives the serialized expression of the rational numbers, denoted as Q^S, However, it has two disadvantages.

There is always a duplication of numbers. For example, $\frac{1}{2}$ equals to $\frac{2}{4}$, $\frac{4}{8}$, and $\frac{8}{16}$. All of them are included in the general term formula, which causes the duplication. About the improvement, this paper

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probably finds a basic formula, and get a complete rational number system by multiple them or divide them by numbers. It can avoid the problem of duplication.

Also, according to Gödel incompleteness theorems, either truth or provable can exist [7]. This paper shows that it is feasible. But it does not necessarily mean it is true. It may be that after a lot of computing it will be found to be flawed, but it may also be solved. It just cannot be known by people now.

Fortunately, people can use that to have a deeper understanding of the composition of structurer of rational numbers and make a better utility. Through this serializing way, when researchers are dealing with contents include rational number, they can use that way to simplify the questions and procedures. For example, when scientists and mathematicians need to handle large amount of XML, JSON and 2-digits files, they can use plenty of dataset to do [8]. And in the content of the file, they can use QS to simplify the expression of rational numbers, in order to do better researches, like the analysis of exponential function [9-10].

This new concept Q^S , the serialized representation of rational numbers, may help people better understand the composition and structure of rational numbers and better use them. By thinking and finding the regularity in rational number, it may improve people's ability to understand and handle various situations.

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